Comp. 7.13

U. S. Department of Agriculture

Forest Service

APPALACHIAN FOREST EXPERIMENT STATION

Technical Note No. 20
Management - Southern Pines

Asheville, North Car.
February 25, 1936.

Converting Factors for Loblolly Pine Pulpwood

By

A. L. MacKinney, Associate Silviculturist
and L. E. Chaiken, Assistant Forester

Pulpwood is invariably referred to in terms of cords. This unit is a direct measure not of the amount of usable wood, but of the amount of space occupied by stacked wood. Obviously, many factors govern the amount of usable wood in any given pile. Before the volume of wood can be accurately estimated these factors must be evaluated. The most important ones to be considered are the size of the pile, the length, diameter, shape and form of the sticks, the amount of bark on them, the presence or absence of long knots, whether the wood is round or split, and the length of time the wood has been piled.

This paper presents the results of a study of converting factors for stacked cords. Two hundred and forty six loblolly pine trees were cut into pulpwood bolts 5-feet long which were stacked in three different ways: (1) by one-inch tree diameter[1/] classes, before peeling; (2) by one-inch tree diameter classes, after peeling; and (3) by one-inch bolt diameter[2/] classes, after peeling. All wood was used above a 0.7 foot stump to a top diameter of 3.6 inches inside bark. All data presented are for bolts 5-feet long piled in cords 8-feet long and 3.2-feet high[3/], and occupying 128 cubic feet of space. Bolts 5-feet in length were used because approximately 80 percent of the pulpwood sticks now cut in the Middle Atlantic Coastal Region are of this length.

Freshly Stacked Wood

Under present conditions, the pulpwood operator wants an average converting factor which can be applied to give a reasonably accurate estimate of the solid wood content of a stack. In the present study, a cord of freshly

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1/ Measured at 4.5 feet above ground, outside bark.

2/ Measured at small end inside bark.

3/ All figures are for cords of this size unless otherwise specified.

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piled, unpeeled, round, loblolly pine pulpwood was found to contain on the average 64.1 percent solid wood, 19.2 percent bark, and 16.7 percent air space. These average figures when applied to cords made up of small bolts - 3 to 7-inches in diameter - give estimates of solid wood which are too high, and when applied to cords containing a majority of sticks over 8-inches in diameter, give an under-estimate of the amount of solid wood.(See Figure 1). The same holds true for peeled wood, for which the average percentage of space occupied by solid wood is 76.8.

Converting factors, more accurate than the average values presented above, may be obtained from Figure 1 if the average diameter of the bolts in individual piles is known. Usually, however, it is not practicable to determine the average diameter. Therefore, Figure 2, showing the relation between number of bolts and converting factors, is presented for use when more accurate values are desired. This figure is based on average number of bolts per square foot of the side face (longitudinal section) area of the stack. In practice, the average number of sticks per square foot of side face area is easily determined by dividing the number of sticks in the pile by the product of length and height of stack.

The application of these converting factors affords good estimates of the amount of solid wood in freshly stacked piles of 5-foot loblolly pine pulpwood, when the bolts are round and straight and all protruding knots and branch stubs have been cut off. If cords are made up of wood which is excessively crooked, has been split, is cut in other than 5-foot lengths, or has not been trimmed carefully, estimates will not be so accurate. The study here reported did not consider these factors because most of the loblolly pine pulpwood now used is cut in 5-foot lengths and is round, straight, and smooth. Furthermore, the amount of crook, the number and length of protruding knots and the proportion of split wood present vary so much from cord to cord that application of any constant correction to the converting factors is not recommended. Each operator must make appropriate allowances as conditions dictate. The following table of the range of allowances is summarized from previous work on other species[4/] and may be helpful in cases where unusual conditions prevail.

4/ Chapman, H. H., and Demeritt, D. B. Elements of Forest Mensuration. pp. 29-35.

Table 1. - Approximate limits of corrections to be made to percentage converting factors when pulpwood is cut in lengths other than 5-feet, or is crooked, knotty, or split.

Factors affecting amount of solid wood per cord.		Approximate correction to be applied to percentage converting factors.
		(Percent)
Length of stick	4'	+ 1.0 to 1.5
	5'	0
	6'	- 1.0 to - 1.5
	8'	- 5.0 to - 6.0
Excessive crook		- 5.0 to - 10.0
Protruding knots or branch stubs		- 3.0 to - 15.0
Split wood (size of correction dependent on proportion of split wood in pile)		- 1.0 to - 7.0

Settled Stacks of Wood

The converting factors presented above apply to freshly piled wood. If piles have been allowed to stand a month or longer, or have been subjected to settling influences such as truck hauling or transportation on railroads, considerable vertical shrinkage will have taken place due to the tendency of the wood to settle. The amount of this shrinkage in the height of the pile varies widely with the compactness of the original piling, but usually averages about 10 percent. For cords 3 to 5-feet in height, this vertical shrinkage results in a greater compactness of the bolts equivalent to an increase of between 7 and 9 percent in converting factors.

Practical Application of Converting Factors

Frequent checks on the amount of solid wood actually contained in stacked piles should result in transactions more equitable to both buyer and seller, as well as assist in putting a premium on good pulpwood manufacturing practices. Both the seller and buyer should insist on a careful measurement of the stacks of wood as well as the recognition of the several variables affecting the solid volume of wood in stacks.

The process of making the essential checks is simple. The mean length of each pile should be determined by averaging two measurements, one taken at the top and the other at the bottom of the pile. These measurements should be made parallel to the ground. The height of the stack of wood should be measured perpendicular to the base of the pile at not less than three foot

intervals, and the several measurements averaged to obtain the mean height. The product of the mean height and the mean length, multiplied by the length of the pulpwood bolts will then give the space occupied by the pile of wood. The next step is to determine the correct converting factor.

If a large number of piles are to be measured, the average converting factor of 64.1 percent for unpeeled wood and of 76.8 percent for peeled wood will usually be satisfactory if the wood is freshly piled and is round, smooth, and 5-feet long. If these conditions are not fulfilled, appropriate corrections given in Table 1 should be applied to the converting factors. Case 1 illustrates the procedure:

Case 1

Measurements of pile:

Length top	8.4 feet
Length bottom	8.0 "
Mean	8.2 feet
Height	4.2 feet
	3.8 "
	4.0 "
Mean	4.0 feet

Description of wood: Peeled, straight, piled for 2 months, round, fairly knotty, bolts 6 feet long.

Computations:

Stacked volume: Length of pile x Height of pile x Length of bolt: 8.2' x 4.0' x 6.0' = 196.8

Converting factor: Mean for peeled wood 76.8%

Corrections:

For length of stick	-1.2%
For knottiness	-5.0%
For settling	+8.0%
	+1.8%

Corrected converting factor 76.8% + 1.8% = 78.6%

Cubic volume of wood: Stacked volume x corrected converting factor = 196.8 x 78.6% = 154.7 cubic feet.

If an accurate estimate of the amount of solid wood in a few piles is desired, the bolts in each stack should be counted and the converting factors presented in Figure 2 used with or without corrections, depending on the condition of the wood. An example of the use of these converting factors is given in Case 2:

Case 2

Measurements of pile:

Length top	6.2	feet
Length bottom	6.8	"
Mean	6.5	feet
Height	5.3	feet
	4.4	"
	4.7	"
Mean	4.8	feet

Description of wood: Rough, freshly piled, round, straight, all knots trimmed flush, bolts 4 feet long, 140 bolts in pile.

Computations:

Stacked volume: 6.5' x 4.8' x 4.0' = 124.8

Converting factor: For 140 bolts in 31.2 square feet of side face area (6.5' x 4.8') 140 ÷ 31.2 = 4.49 sticks per square foot of side face area. Reading from Figure 2 (B), converting factor is 62.4%.

Corrections:
For length of stick +1.2%

Corrected converting factor 62.4% + 1.2% = 63.6%

Cubic volume of wood (excluding bark):
Stacked volume x corrected converting factor =
124.8 x 63.6% = 79.4 cubic feet.

Application to Standing Timber

Frequently when timber is cruised, it is necessary to convert the cubic volume estimated from volume tables into cords. Converting factors for trees of different sizes can be used for this purpose. Figure 3 shows the percentage of solid wood per stacked cord of both rough and peeled wood when made up of trees of different diameters. In using these converting factors to determine the number of cords of space occupied by a known volume of solid wood, the volume of solid wood should be multiplied by $\left(\frac{100}{\text{converting factor}} \div \text{the number cubic feet stacked space per pile}\right)$.

Case 3 illustrates the procedure:

Given: 1,472 cubic feet of peeled, merchantable wood from 8-inch trees.

To determine: The number of stacked, peeled cords, 8' x 4' x 5', which this cubic volume will make.

Converting factor: For 8-inch trees from Figure 3 is 75.5%

Computations: $1472 \left(\frac{100}{75.5} \div 160 \text{ cu. ft.}\right)$

$= 1472 \ (1.325 \div 160) = 1472 \ (.00828) = 12.19$ cords.

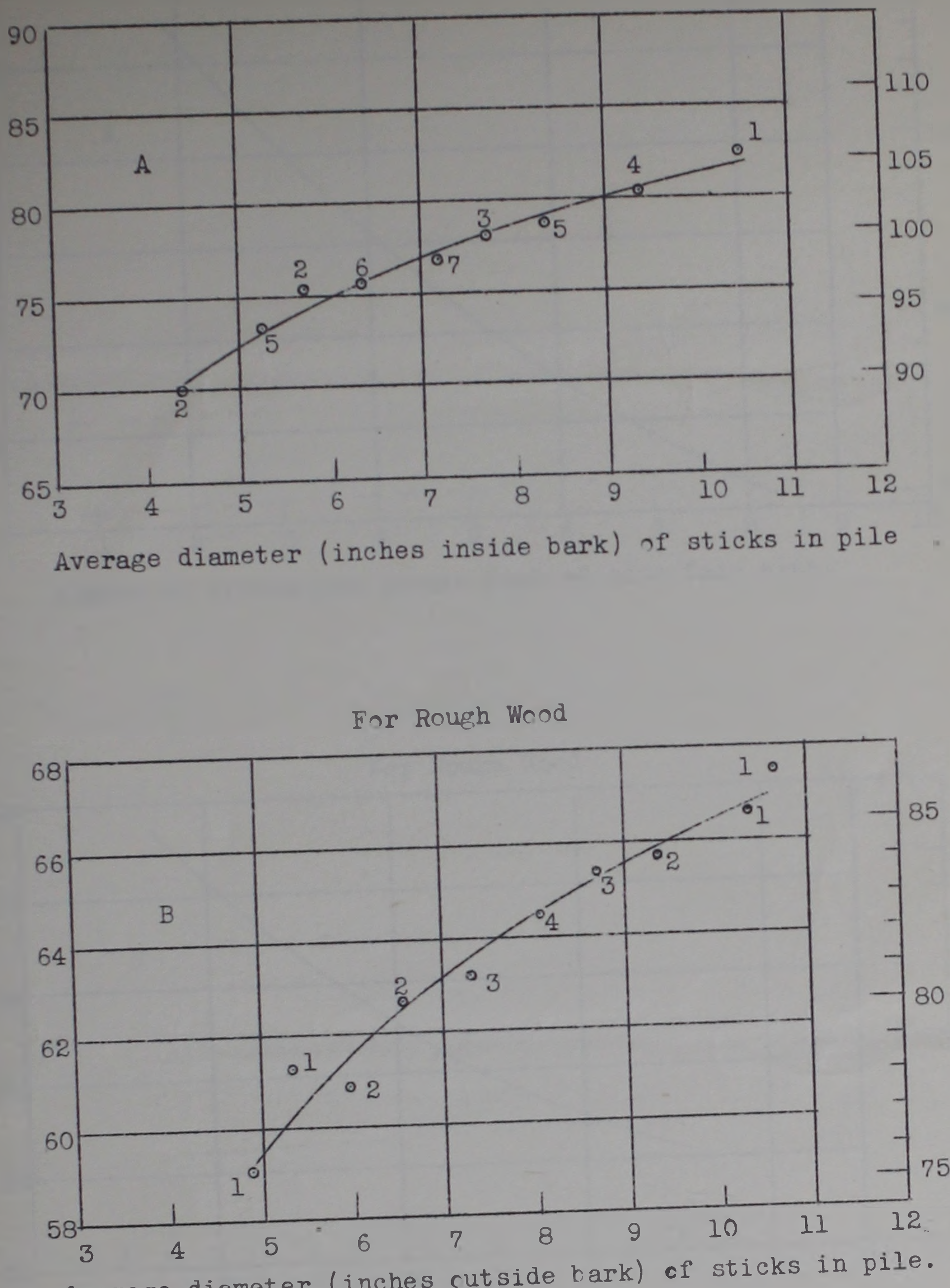


Figure 1. - Converting factors for loblolly pine pulpwood showing the percentage of stacked space occupied by solid wood (exclusive of bark) in piles having different average bolt diameters. (A) For peeled wood. (B) For rough (unpeeled) wood.

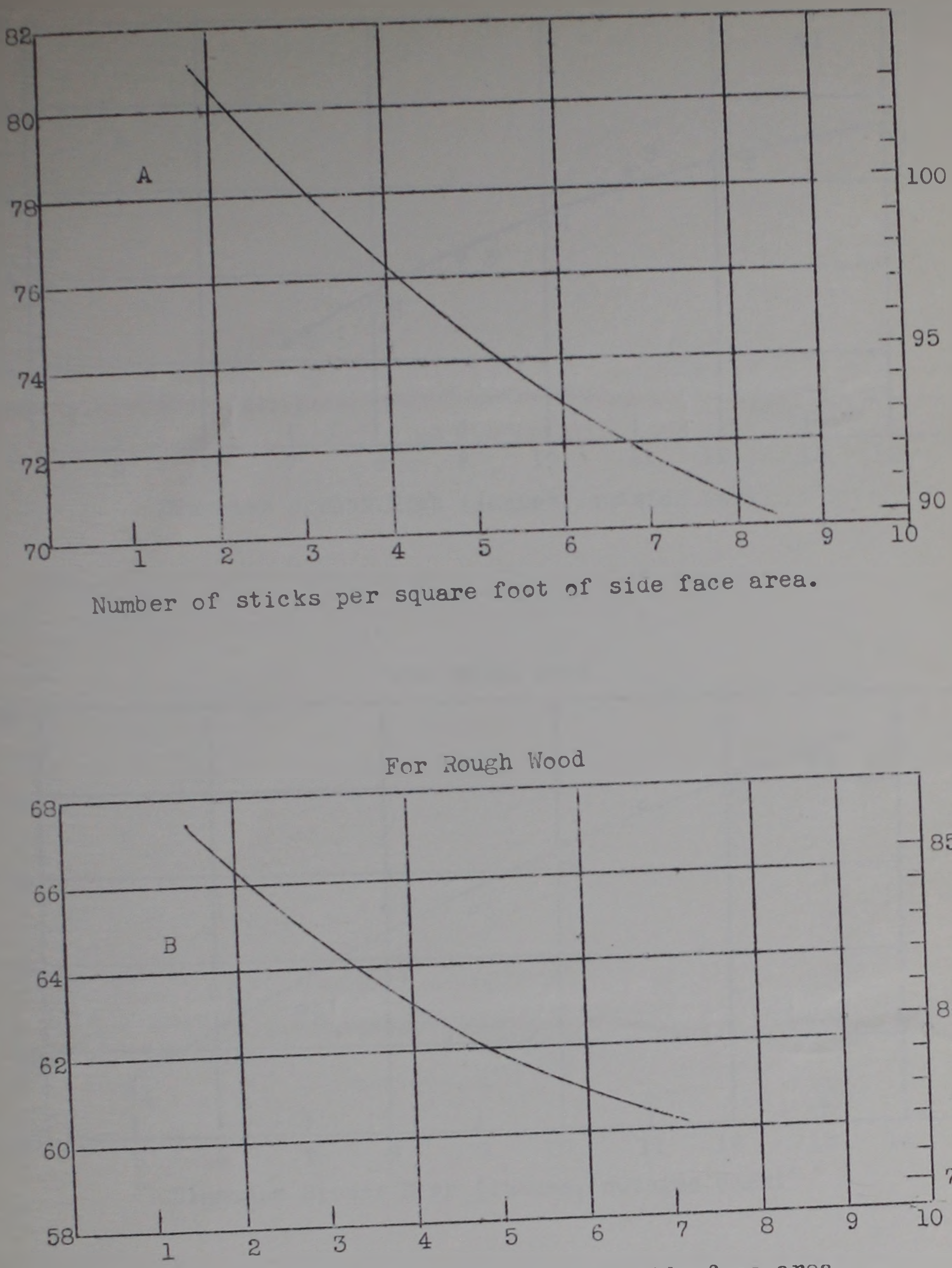
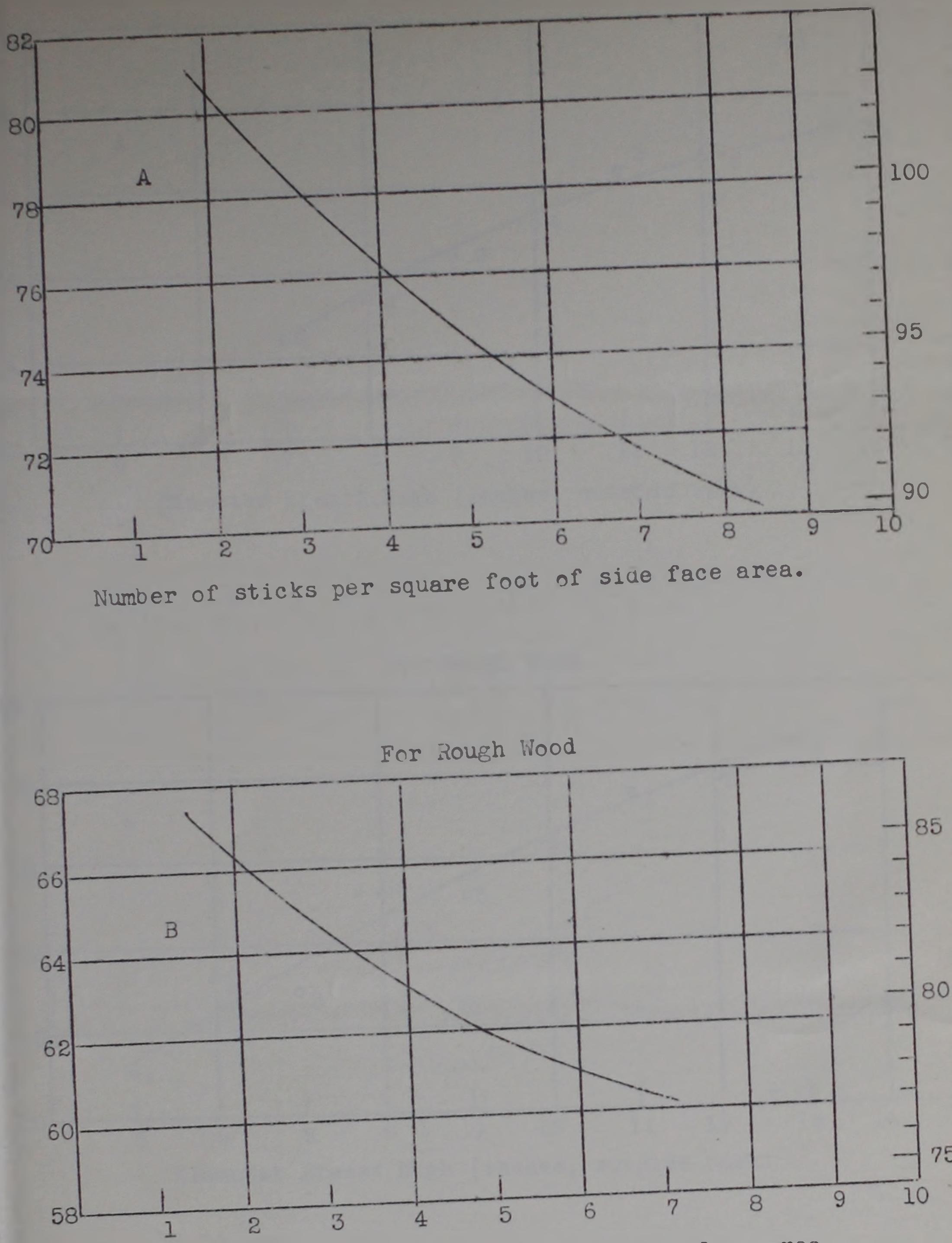


Figure 2. - Converting factors for loblolly pine pulpwood showing the percentage of stacked space occupied by solid wood (exclusive of bark) in piles containing different numbers of sticks per square foot of side face area. (A) For peeled wood. (B) For rough (unpeeled) wood.



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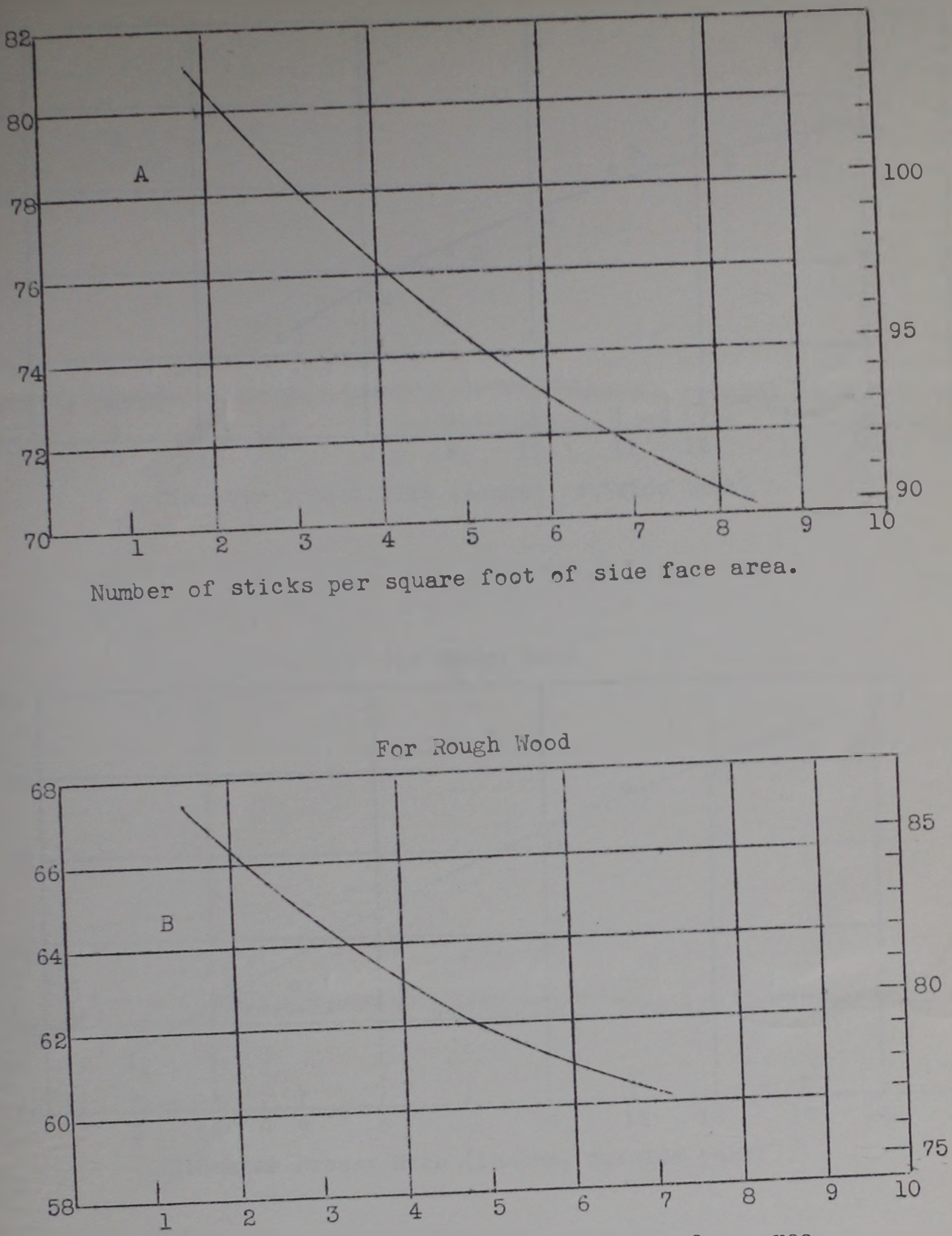

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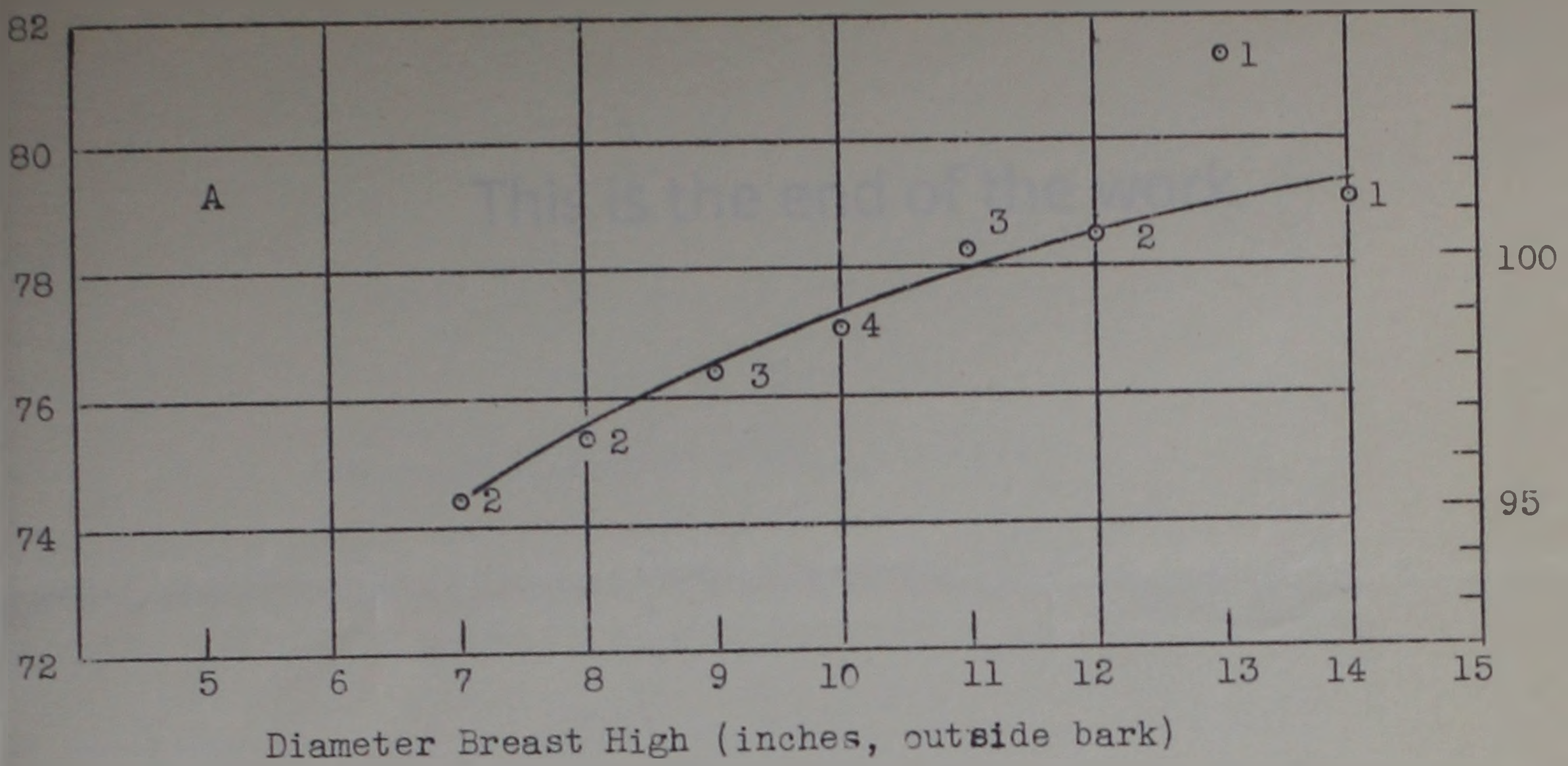
For Peeled Wood



For Rough Wood

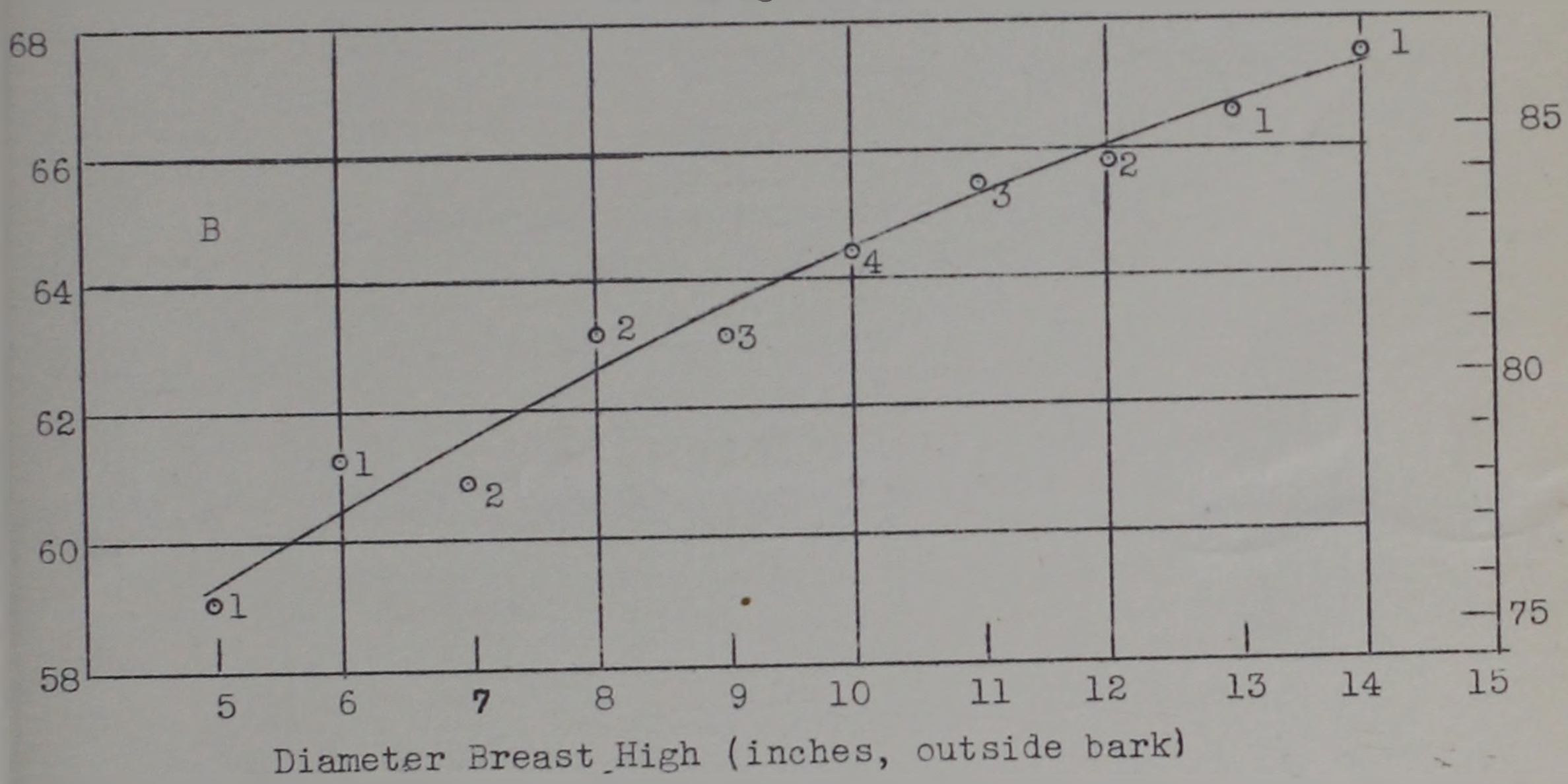


Figure 3 - Factors for use in converting cubic volume in trees of different diameters into terms of stacked cords. (A) For peeled wood. (B) For rough (unpeeled) wood.